



# FROM ROAD TRAFFIC TO ROAD SAFETY: THE PARADIGM SHIFT TO SAVE LIVES

By Cássio Mattos Honorato

## 1. INTRODUCTION

For almost half a century, I have witnessed the repetition of some speeches that, due to lack of effective results and scientific achievements, led me to question their validity. Among these, these statements stand out: that Road Traffic consists of three *elements*: Engineering, Education and Enforcement, and that it is represented graphically as a triangle formed by three letters “E” (the 3E System); and the argument that, because human beings are responsible for more than 80% of road traffic collisions, they are considered the viruses of the system and, therefore, they needed to be *neutralised*. These are anomalies resulting from an outdated and ineffective system, developed during the 1940s and 1950s, in which the traffic phenomenon was seen as an economic interest (arising from the transport of people and goods) and road traffic injuries were considered the price of motorization.



Photo credit: Tim Samuel, Pexels, Driver sitting in cab and fastening seat belt, 2020. <https://www.pexels.com/photo/unrecognizable-male-driver-sitting-in-cab-and-fastening-seat-belt-5834963/>

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*“Know this well, when we can prevent death, letting die is killing.”*

– Victor-Marie Hugo, 1854

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Photo credit: Larry, Driving in Italy, not for me!, 2006. <https://flic.kr/p/jcwWE>

However, this paper maintains that the increase in road traffic deaths, in Brazil and other low- and middle-income countries, arises from underlying and deeper problems, such as the absence of basic concepts (based on scientific achievements) and the lack of application of the principles related to road safety.

For instance:

- 1) **The use of land roads, in fact, is not a right but a set of duties imposed on all those who want to make use of the public space designated for road traffic.**
- 2) **The license to drive is not an inherent right, but a privilege granted through an administrative act (called a driving licence) that allows a risky activity to be carried out, subject to safety standards imposed and enforced by the State.**
- 3) **Road traffic is not the mere use of land roads, in an individual sense; but a means to participate in a historical and social phenomenon, which caused 1.19 million deaths in 2021 around the world and “remains the leading cause of death for children and young people aged 5–29 years” (WHO, 2023, p. 4).**

The identification of these anomalies is the beginning of a *scientific revolution*, which aims to move road traffic policy away from economic interest and focus their actions on preserving life. According to TOMAS KUHN (2012, p. 6):

*“And when it does - when, that is, the profession can no longer evade anomalies that subvert the existing tradition of scientific practice - then begin the extraordinary investigations that lead the profession at last to a new set of commitments, a new basis for the practice of science. The extraordinary episodes in which that shift of professional commitments occurs are the ones known in this essay as scientific revolutions. They are the tradition-shattering complements to the traditional-bound activity of normal science. [...]. Such changes, together with the controversies that almost always accompany them, are the defining characteristics of scientific revolutions.”*

This *scientific revolution* reveals that the 3E System is outdated, that a safe system is much more than just “3E” (Engineering, Education and Enforcement) focusing on a single *element*, and the concept of road traffic needs to be reinterpreted in its social and collective sense, in which the State assumes the role of protecting the fundamental rights to life and health of road users, as the guarantee of a Human Right called Road Safety.



Photo credit: Derek Lee, Vehicle and road safety, 2022. <https://unsplash.com/photos/a-car-on-the-road-PPzzMw43RTQ>

The anomalies that hinder the reduction of road traffic deaths are the basis for the *scientific revolution* that will transform Road Traffic into Road Safety, providing social use of land roads, under conditions in which none of the participants will die or suffer serious injuries, even if crashes occur.

Aware of this *scientific revolution*, this article highlights the evolution of road safety management systems, mentioning the main characteristics of each phase and indicating more modern and efficient models, in which the protection of life constitutes the core and goal of the road safety policy.

## 2. UPDATING THE SYSTEM TO ACHIEVE ROAD SAFETY

What is needed, then, to change the current reality and achieve the goal of zero road traffic deaths?

The first step to think beyond the 3E System was taken by Doctor Leslie George Norman in 1962, when the problem and its greatness were identified. According to his report (NORMAN, p. 17), road traffic injuries “*constitute a public health problem of the first magnitude,*” so “*accidents have become a new ‘epidemic’ of public health importance calling for equal effort for control and prevention*” (1962, p. 7). The author (NORMAN, p. 9) also asserts that “*this catastrophic loss and injury is a public health problem demanding urgent attention*”.

The *global road safety crisis* was recognized by the United Nations (through Resolution A/57/309 and Report A/58/228), in 2003. As it is a public health problem at global level, in 2004 the World Health Organization (WHO) was invited “*to act as a coordinator on road safety issues within the United Nations system*” (UN A/Res/58/289, item 2).

Once the magnitude of the problem is understood and the anomalies related to its nature are overcome, it is necessary to identify the techniques or instruments that can be used to break the 3E System limits, to develop comprehensive road safety systems, and to reduce road traffic deaths. Toward this end, some tools were developed in the late 1960s and early 1970s, giving rise to the second phase of road traffic management systems (described in Section 3.2 below).

### 2.1. Ten strategies to reduce energy transfer (during crashes)

In the 1970s, Doctor William Haddon Jr. developed worthy *strategies* to identify risks and reduce the consequences and severity of injuries resulting from energy transfer during crashes. Using the suggestive title *On the Escape of Tigers* (HADDON Jr., 1970), the author highlighted *ten strategies* that can (and should) be applied to reducing road traffic losses:

#### TEN STRATEGIES FOR REDUCING LOSSES (HADDON Jr., 1970)

|    |                                                                                                                                                           |                               |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1  | To prevent the marshalling of the form of energy in the first place                                                                                       | $E = \frac{1}{2} m \cdot v^2$ |
| 2  | To reduce the amount of energy marshalled                                                                                                                 | SPEED                         |
| 3  | To prevent the release of the energy                                                                                                                      | SAFETY SYSTEM                 |
| 4  | To modify the rate or spatial distribution of release of the energy from its source                                                                       | SEAT BELTS                    |
| 5  | To separate, in space or time, the energy being released from the susceptible structure                                                                   | SIDEWALKS                     |
| 6  | To separate by interposition of a material “barrier”                                                                                                      | HELMETS                       |
| 7  | To modify appropriately the contact surface (as in eliminating, rounding, and softening corners, edges, and points with which people can come in contact) | VEHICLE DESIGN                |
| 8  | To strengthen the structure that might otherwise be damaged by the energy transfer                                                                        | HUMAN BODY TOLERANCE          |
| 9  | To move rapidly in detection and evaluation of damage, and to counter its continuation or extension                                                       | MEDICAL CARE                  |
| 10 | To encompass reparative and rehabilitative measures to return to the pre-event status or stabilization in structurally or functionally altered states     | REHABILITATION                |

The table above summarizes the *ten strategies* developed by HADDON Jr. In addition, in the third column, it is worth noting some of the strategies pertinent to the key risk factors for road safety: speeding, non-use of seat belts and safety helmets (UN A/Res/60/181, item 16).

Regarding the first and second strategies, it is necessary to remember that reducing speed limits is a technique that decreases the volume of energy generated by vehicle movement. This energy is called the *kinetic energy*. Speed has a great influence on the volume of energy, which can be determined by the equation  $E = (\frac{1}{2}.m)v^2$ , in which the amount of energy interchanged during crashes is equal to one half of mass multiplied by the square of the vehicle velocity (GRSP, 2023, p. 12).

It is estimated that reducing speed limits on a road by 10% (ten percent) results in 37.8% fewer road traffic deaths (ELVIK, 2004, p. 3). For this reason, speed management constitutes the core of road safety systems (WHO, 2004, p. 76).

To modify the rate or spatial distribution of energy released during a traffic crash (Strategy 4), it is recommended that all vehicle occupants use seat belts. The seat belt distributes the energy released at the time of a collision across the strongest parts of the body (chest and pelvis), in addition to reducing the risk of contact with the interior of the vehicle and other passengers.

The necessity for motorcyclists to use safety helmets constitutes a strategy (strategy 6 in Haddon's framework) that aims to keep away the energy released (in case of crash or fall from the motorcycle) from the structure to be preserved: the driver's head.

Regarding the eighth strategy (strengthening the structure susceptible to damage), it is essential to acknowledge that the human body is fragile and is susceptible to injuries during crashes. Therefore, it is imperative to adapt the road system to the human's body vulnerability; a system that is "**built around the human tolerance for mechanical forces**" (TINGVALL & HAWORTH, 1999), and developed to safeguard life and health of road users.

The final two strategies focus on the care provided to victims in the post-crash phase, especially emergency medical care, victims transport and long-term rehabilitation process. It is important to note that "**actions to improve the post-crash response**" are foreseen in the *Global Plan for the Decade of Actions for Road Safety 2021-2030* (WHO, 2021, p. 17).

Although the strategies are numbered (from 1 to 10), HADDON Jr. (1970, p. 2232) clarifies that there is no logical sequence, order of classification or priority in relation to the techniques mentioned above. However, "**the larger the amounts of energy involved in relation to the resistance to damage of the structures at risk, the earlier in the countermeasure sequence must the strategy lie. In the ultimate case, that of a potential energy release of proportions that could not be countered to any satisfactory extent by any known means, the prevention of marshalling or of release, or both, becomes the only approach available.**"

**Prevention:** this is a great strategy to mitigate the consequences of a public health problem of the first magnitude.



Photo credit: Waldemar, A Helmet Saves Life, Hamburg, Deutschland, 2020.  
<https://unsplash.com/photos/woman-in-gray-coat-wearing-black-helmet-standing-on-road-during-daytime-hqAt9Fmp2cs>

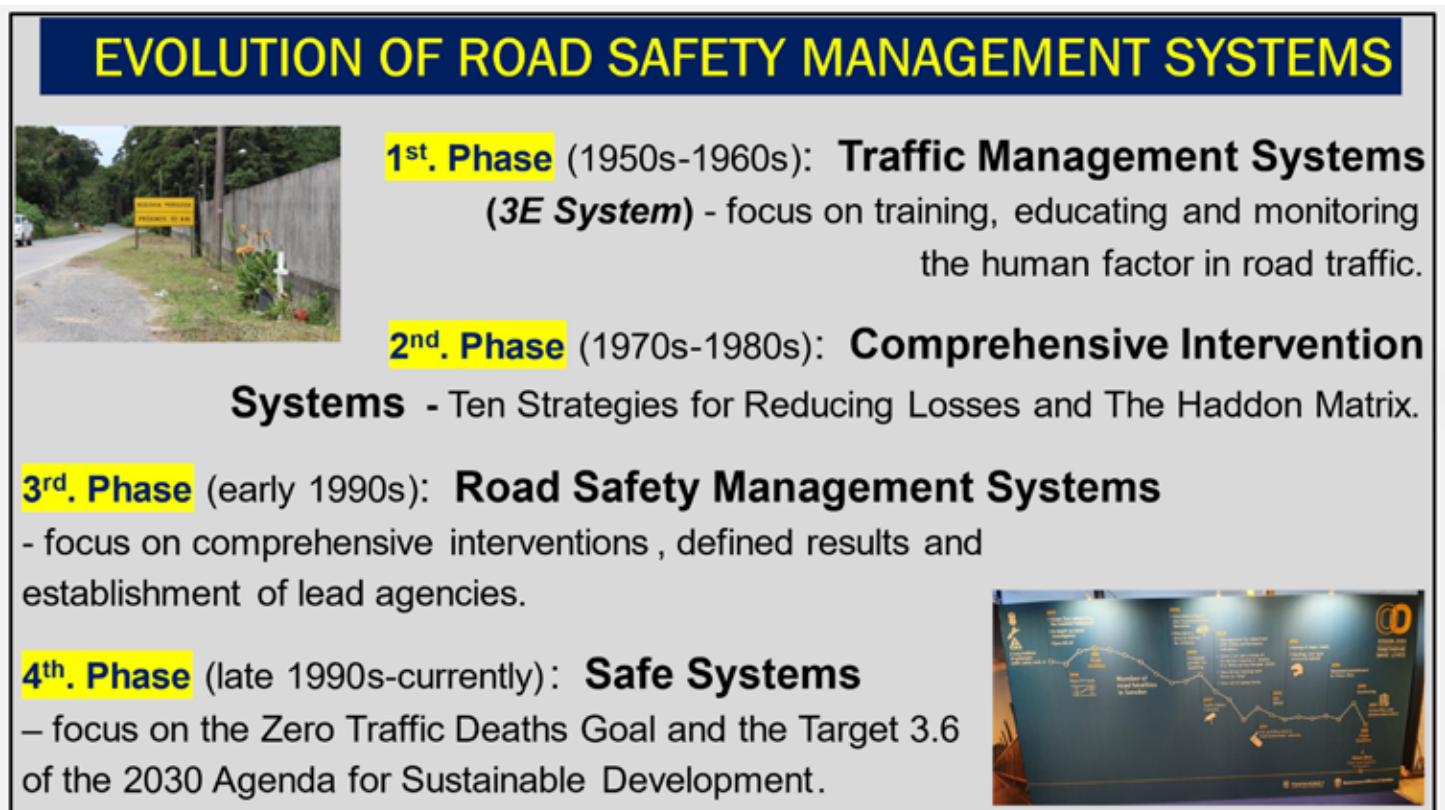
## 2.2. Preventing the release of the energy and protecting the human body

**Prevention and collective responsibility:** these points constitute the primary shortcomings of the 3E System. This system concentrates its actions on a single *element* (*focus on intervention on drivers*), thereby impeding the development of a holistic and proactive road safety system (OECD/ITF, 2016, p. 9), in which the State understands the complexity of the traffic phenomenon and embraces Road Safety as a Human Right. Thus, it is necessary that the State assumes the role of guarantor of road safety, creating safety standards and monitoring compliance by all actors who impact (directly or indirectly) road safety.

To this end, it is crucial to abandon the comfortable thought related to the exclusive responsibility of the human factor in road traffic (mainly drivers) and to start thinking about systems in which responsibility is collectively shared among all stakeholders, including governments and the private sector. This criticism is shared by Haq & Whitelegg (2014, p. 114):

*“Thirty years ago, Whitelegg (1983) argued that there is a significant policy deficit in approaches to road safety. [...] Road safety policy is still very reluctant indeed to address fundamental structural solutions to the problem of “road traffic accidents” and the basic changes to system design that these solutions would involve.”*

To understand how outdated the 3E System is, and the need to break its paradigms, it is necessary to highlight (albeit briefly) the phases that allowed the creation of current road safety systems.



(Figure 1: Evolution of Road Safety Management Systems. Photos by author)

### 3. EVOLUTION OF ROAD SAFETY MANAGEMENT SYSTEMS

The criticism made here does not constitute a mere personal opinion; but it derives from scientific research (BLISS & BREEN, 2009) that reveal the existence of four distinct and successive phases of the road safety management systems:

- (1st) Focus on interventions on drivers (identified in this research as **3E System**);
- (2nd) Focus on comprehensive interventions (based on Haddon Matrix);
- (3rd) Focus on comprehensive interventions, with defined outcomes, and establishment of lead agencies; and
- (4th) Implementation of road safety systems, with a focus on reducing and/or eliminating the number of deaths and serious injuries in road traffic, by sharing responsibilities.

It is regrettable to realize that Brazil and other low- and middle-income countries are still limited to the characteristics of the first phase (3E System), in which (i) interventions are focused on the individual responsibility of vehicle drivers; (ii) omitting itself in relation to other (public and private) actors, who should play essential roles in road safety.

Furthermore, (iii) the traffic management systems are devoid of (clear and achievable) goals and lead agencies (endowed with responsibility, political will and budget) capable of planning and coordinating the implementation of the necessary interventions to reduce road traffic injuries. Therefore, it is imperative to highlight the main characteristics of the four evolutionary phases (from traffic management systems to safe systems), so that stakeholders can identify the phase in which their country's road traffic management system currently is and the steps necessary to achieve the Human Right to Road Safety.

### 3.1. First phase: focus on interventions on drivers

The 3E System was developed in the first decades of the 20th Century and has had a significant influence on the Road Traffic Codes that have been in force in Brazil since 1941. At that time, the actions of road traffic agencies were focused on vehicle drivers, through the creation of road traffic laws (legislative intervention) and the imposition of penalties on violators of these rules (administrative intervention through enforcement and criminal prosecutions), with the expectation of promoting behavioural change.

The argument appeared simple: as the human factor constitutes the main cause of crashes and road traffic deaths, this *element* should be *neutralised* through Education and Enforcement. Kåre RUMAR's (1999, p. 3) criticism of this argument is noteworthy:

*"The main message of this lecture is that the human factor both in terms of behaviour and physical vulnerability is the main problem in transport safety. Therefore, we have to take a number of technical and organisational actions to neutralise the human factor to achieve safety in the traffic system."*

Two characteristics identify this first phase of road safety management systems: First, interventions focus on a single *element*: the human behaviour. Thus, the State exempted itself from its responsibility (as guarantor of the Human Right to Road Safety); it neglected the necessary proactive actions, in order to avoid the recurrence of serious crashes (sometimes with the same causes and consequences), and it overlooked other protagonists of the traffic phenomenon (for instance, system designers and automobile industry). According to RUMAR (1999, p. 21),

*"There are four main actors on the traffic safety scene: (i) Road users (we are all road users by foot, bicycle, public transport or car); (ii) Authorities (local, regional, national and international); (iii) Voluntary organisations; (iv) Industry. If we look into the rear-view mirror, we will probably realise how badly organised the roles and responsibilities among these four groups and within these four groups have been. We will probably realise that some areas of interest for several actors cover traffic safety while other areas are not covered by anyone. It seems that this is a specific problem to the EU on the one hand in relation to national authorities and on the other hand within the EU (several directorates deal with road safety). It is very important that responsibility and power follow each other."*

The second striking characteristic of this first phase is the absence or insufficiency of lead agencies that, in fact, would establish goals and coordinate the road safety system and the multiple functions to be performed by entities related to road safety at national, regional and local levels. The creation of lead organisations is recommended by the *World Report on Road Traffic Injury Prevention* (WHO, 2004, p. 160): *"Recommendation 1: Identify a lead agency in government to guide the national road traffic safety effort."*

But a *scientific revolution* occurred in the 1960s: the increase in road traffic deaths caught the attention of the United Nations, and it was recognized as a *"major public health problem of the first magnitude"* (NORMAN, p. 17).

### 3.2. Second phase: focus on comprehensive interventions

The second phase of road safety management systems was strongly influenced by the studies of William Haddon Jr., who, in addition to the *ten strategies* highlighted in Section 2.1 above, proposed a new approach to traumas prevention, with the aim of identifying its origins and the necessary interventions to mitigate its consequences. According to Haddon (1968, p. 1432): *“the ability to describe human morbidity and mortality etiologically requires an understanding of causation. Hence it opens the door to the possibility of manipulation and control”*

To this end, Haddon (1968, p. 1434-1435) developed a matrix based on three *elements* (infrastructure or environment, vehicle or equipment, and human factor), considered in three successive phases: before, during and after the crash. According to Haddon, the first phase (*pre-crash*) involves the necessary interventions to prevent the *elements* from causing the release of energy. The second phase occurs during the crash, when the forces resulting from the deceleration of movement interact on vehicles, occupants, pedestrians and cyclists. The final phase (*post-crash*) contains the results (or consequences) of the event, and is intended for medical interventions (emergency care, transport, hospitalization) and rehabilitation of the victims.

The Haddon Matrix can be represented by the Table below, developed (a few years later) by WHO and Indian Institute of Technology Delhi (2006, p. 24):

#### THE HADDON MATRIX

|            |                                    | FACTORS                                                      |                                                                        |                                                                      |
|------------|------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------|
| PHASE      |                                    | HUMAN                                                        | VEHICLES & EQUIPMENT                                                   | ENVIRONMENT                                                          |
| Pre-crash  | Crash prevention                   | Information<br>Attitudes<br>Impairment<br>Police enforcement | Roadworthiness<br>Lighting<br>Braking<br>Handling<br>Speed management  | Road design and road layout<br>Speed limits<br>Pedestrian facilities |
| Crash      | Injury prevention during the crash | Use of restraints<br>Impairment                              | Occupant restraints<br>Other safety devices<br>Crash protective design | Crash-protective roadside objects                                    |
| Post-crash | Life sustaining                    | First-aid skill<br>Access to medics                          | Ease of access<br>Fire risk                                            | Rescue facilities<br>Congestion                                      |

Thus, in the 1970s and 1980s, the *3E System* was replaced by more comprehensive intervention systems, addressing the multiple risk factors that interact at different phases, resulting in crashes.

Despite the scientific advancements achieved during this second phase, studies reveal two points that hindered the attainment of the expected results: First, Bliss & Breen (2009, p. 14) argue that *“the focus remained at the level of systematic interventions and did not directly address the institutional management functions producing these interventions or the results that were desired from them.”* Second, the limited number of lead agencies and the need to establish their role as a coordinating agency for the road safety system.



Considering that road traffic death rates were not reduced throughout the 1970s-1980s, the OECD/ITF (2016, p. 5) asserted that *“it became clear a predominant focus on education, information, regulation and enforcement was no longer delivering progress. A rethink was needed,”* and a new focus on the road safety systems became necessary.

### 3.3. Third Phase: Focus on comprehensive interventions, with defined outcomes and the establishment of lead agencies

The 1990s were a landmark decade for the evolution of road safety management systems, encompassing both the third and fourth phases, which revealed the need to shift the *3E System* paradigm to achieve comprehensive interventions and to reduce road traffic deaths. Based on the comprehensive intervention systems developed in the previous phase (Haddon Matrix), some countries identified the necessity to create lead agencies and establish coordination processes between entities related to the traffic phenomenon. According to the WHO (2004, p. 14):

*“The experience of several countries indicates that effective strategies for reducing traffic injury have a greater chance of being applied if there is a separate government agency with the power and the budget to plan and implement its programme.”*

The creation of lead agencies, which could guide national efforts, coordinate the work of other organisations in the system and set long-term goals and intermediate objectives, constituted the main characteristic of this third phase. The expression *focus on comprehensive interventions* was well understood by the WHO (2011, p. 9-17) when it encouraged countries to implement *national activities* in five major areas (called *pillars*) to reduce road traffic deaths by at least 50% during the first Decade of Action for Road Safety 2011-2020: road safety management, safer roads and mobility, safer vehicles, safer road users, and post-crash response. The following Table was developed by WHO (2011, p. 11) and it identifies the *five pillars* of actions to reduce road traffic deaths:

#### FIVE PILLARS OF ACTIONS TO REDUCE TRAFFIC DEATHS

| NATIONAL ACTIVITIES                      |                          |                |                  |                     |
|------------------------------------------|--------------------------|----------------|------------------|---------------------|
| PILLAR 1                                 | PILLAR 2                 | PILLAR 3       | PILLAR 4         | PILLAR 5            |
| Road Safety Management                   | Safer Roads and Mobility | Safer Vehicles | Safer Road Users | Post-crash Response |
| INTERNATIONAL COORDINATION OF ACTIVITIES |                          |                |                  |                     |

The road safety system should be based on at least these *five pillars*, equipped with a series of activities (as outlined in the *Global Plan for the Decade of Action for Road Safety 2011-2020* – WHO, 2011, p. 12-17) capable of guiding the actions to be undertaken by road safety agencies.

This third phase represented a significant advancement. There remained, however, one objective to be attained: the establishment of a road safety system dedicated to reducing, and ultimately eliminating, the number of deaths and serious injuries resulting from road traffic.

### 3.4. Fourth Phase: Implementation of road safety systems, with focus on reducing road traffic deaths and serious injuries, by sharing responsibilities

The fourth phase emerged in the late 1990s, bringing together comprehensive interventions (identified in the second phase), within systems coordinated by lead agencies capable of stimulating the multiple activities of the system towards an ambitious goal: zeroing the number of deaths resulting from road traffic crashes.

This phase, however, is not characterized solely by adding the techniques developed in previous phases. A paradigm shift was necessary for transforming road traffic systems into safe systems. In this sense, Haq & Whitelegg (2014, p. 118) explain the core of this *scientific revolution*:

*“[...] It requires abandoning the traditional economic model where road safety is provided at reasonable cost and the traditional transport model in which safety must be balanced against mobility. At the core of the Vision Zero is the biomechanical tolerance of human beings. Vision Zero promotes a road system where crash energy cannot exceed human tolerance. While it is accepted that crashes in the transport system occur due to human error, Vision Zero requires no crash should be more severe than the tolerance of humans. The blame for fatalities in the road system is assigned to the failure of the road system rather than the road user (Wadhwa, 2001).”*

From an ethical imperative (Tingvall & Haworth, 1999): *“It can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system”*, road safety systems are based on three essential points: First, the human body is fragile, and the road safety system must anticipate errors in human behaviour and prevent the release of energy ( $E = \frac{1}{2}m.v^2$ ). Second, road safety systems are dedicated to protecting life and to eliminating road traffic deaths and serious injuries, as the only acceptable number of road traffic deaths is zero (target zero road traffic deaths). Third, responsibility is shared by all actors (public and private), who should play essential roles in road safety.



Photo credit: Eilis Garvey, Rider at intersection, 2022.

[https://unsplash.com/photos/a-man-riding-a-bike-across-a-street-xlwWzI-r\\_o](https://unsplash.com/photos/a-man-riding-a-bike-across-a-street-xlwWzI-r_o)

The paradigm shift necessary to reach the fourth phase (and road safety systems) depends on the recognition of the following *scientific revolutions* related to the traffic phenomenon:

**(1) the identification of Road Safety as a Human Right.**

On this topic, I have already had the opportunity to argue that (Honorato, 2015, p. 33): *“From the merger between Freedom of Movement and the duty of the State to provide Road Security can be extracted the actual content (or meaning) of Road Safety, as a Human Right of Second Dimension which takes in a democratic State the function of a constitutional guarantee in order to ensure traffic in safe conditions and to protect life and physical integrity of all traffic participants.”* In this way, the paradigm shift moves road traffic policy away from economic interest to the protection of life and health. Human beings cease to be mere instruments for transporting goods and merchandise and become the main objective of the system. The economic paradigm yields to the prioritization of life preservation.

**(2) the removal of the myth that human behaviour in road traffic is the only culprit (and therefore needs to be neutralised). Human beings in road traffic are not the risk factor but the reason for the existence of the system, whose function is to protect life and health of road users.**

**(3) the transcendence of the culture of individual responsibility in road traffic, because “the complete fulfilling of Road Safety consists of right and duty of each person and everyone of us!” (Honorato, 2015, p. 25), and**

**(4) the shared responsibility between all actors involved in the traffic phenomenon.**

An example illustrates the difference between the 3E System (from the 1940s-1950s) and current road safety systems: in the event of a serious road traffic crash resulting in deaths and injuries, 3E System operators will initiate investigations and criminal prosecutions aimed at identifying the human conduct that caused the crash and applying penalties prescribed by law. The intervention focuses on the human factor, aiming at finding a road user to blame; but the environment in which the crash occurred remains the same.

Conversely, agents of road safety systems initiate investigations to identify possible failures in the road structure (covering the *five pillars of the Global Plan for the Decade of Action for Road Safety*) and adopt measures to ensure that similar events do not occur again.

#### 4. ROAD SAFETY SYSTEM AND ITS PARADIGM

What, in fact, draws attention to the strategies called *Vision Zero* (Sweden), *Towards Zero* (New South Wales - NSW, Australia), or *Sustainable Security* (Netherlands) is the philosophy, ethical guidance or ethical imperatives associated with them. In these updated road safety models, the following ethical guidelines stand out:

**First: Road traffic deaths are unacceptable.** Haq & Whitelegg (2014, p. 118) summarize this ethical imperative: *“Vision Zero is based on the ethical imperative that (Tingvall and Haworth, 1999): ‘It can never be ethically acceptable that people are killed or seriously injured when moving within the road system.’ Accidents have to be prevented from leading to fatalities and serious injuries by designing roads, vehicles and transport services in a way that someone can tolerate the violence of an accident without being killed or seriously injured.”* The authors (Whitelegg and Haq, 2006, p. 11) prefer to identify the ethical imperative as: *“the loss of human life and health is unacceptable”*.

**Second: “Road traffic crashes are predictable and therefore preventable” (WHO, 2004, p. 164).**

**Third: The protection of life is the paradigm to achieve Road Safety.** Tingvall & Haworth (1999, p. 2) assert that *“Mobility therefore should follow from safety and cannot be obtained at the expense of safety.”* In the same sense, Whitelegg and Haq (2006, p. 7) state that *“Vision Zero requires a paradigm shift in addressing the issue of road safety (Rechnitzer and Grzebieta, 1999). It requires abandoning the traditional economic model where road safety is provided at reasonable cost and the traditional transport model in which safety must be balanced against mobility.”*

In summary, the road safety system must be comprehensive, because road traffic injuries occur in a wide variety of contexts and have multiple causes. Thus, it necessitates a multidimensional approach to encompass all potential causes and factors that, in combination, influence the traffic phenomenon. From this requirement follows the *first conclusion*: the system cannot focus on a single *element*; a holistic and proactive approach is essential.

As a fundamental principle, the road safety system assumes the duty to protect road users, preventing deaths and serious injuries, despite errors and violations of road traffic safety standards committed by them. To this end, the system recognizes the human body tolerance and, assuming that human beings make mistakes and violate road traffic rules, the system takes on the role of protecting road users so that they do not die or suffer serious injuries. From this duty (to guarantee road safety) emerges the *second conclusion*: the function of the road safety system is not only to prevent the human factor from causing a crash; but to develop actions assuming (as happens in the real world) the errors and violations that will lead to crashes, to reduce the consequences of these errors or violations, in order to avoid deaths and serious injuries in roadways.

The evolution of road safety systems reveals the *scientific revolution* of the traffic phenomenon, which abandoned the economic paradigm (of transporting goods and people) and adopted the protection of life as a means of achieving the Human Right to Road Safety.



Photo credit: Denis Rizzoli, Acidente Fundão, Brazil, 2011.  
[https://commons.wikimedia.org/wiki/File:Acidente\\_Fund%C3%A3o.jpg](https://commons.wikimedia.org/wiki/File:Acidente_Fund%C3%A3o.jpg)

## 5. CONCLUSION

Agent Smith (a character from *The Matrix*, 1999) was wrong: humans are not viruses to be *neutralised* by the road traffic management system (as proposed by 3E System). Instead, human factor is its very purpose, and road safety systems should focus on protecting life. Road users are the vulnerable *element* that makes daily use of the land roads, therefore, even in the face of violations or mistakes, they need to be protected by the road safety system.

The paradigm shift, observed in 1962 by Leslie George Norman, received the tools developed by William Haddon Jr. (in the 1970s) and the actions coordinated by World Health Organization (from 2004 to the present), and it enters the 21st Century founded on the ethical imperative that ***road traffic deaths are unacceptable!***

This *scientific revolution*, however, has not yet been incorporated into the road systems of some low- and middle-income countries, where the traffic phenomenon is still based on the Road Traffic paradigm (represented by the 3E System), with a focus on intervention on drivers, and under the economic interest of transporting goods and people. The replacement of the paradigm of the 1940s-1950s will only occur when the Road Safety paradigm, (in which human beings (with their inherent fragility and errors) are placed at the centre of a system dedicated to protecting life and physical integrity of road users) is perceived, accepted, and replaces the outdated paradigm. In this sense, Thomas Kuhn (2012, p. 78) clarifies that:

*“The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgement leading to that decision involves the comparison of both paradigms with nature and with each other.”*

Therefore, it is necessary to reveal the *scientific revolution* that enabled the transition from ***Road Traffic to Road Safety*** and the need to adopt road safety systems that are based on protecting life and health of road users. Such paradigm shift will allow low- and middle-income countries to reduce road traffic injuries and eradicate a public health problem of the first magnitude.

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## AUTHOR NOTES

- (1) The texts originally published in Portuguese or in French were freely translated and the mistakes are mine.
- (2) The initial quote by Victor-Marie Hugo (1802-1885) was extracted and adapted from the Open Letter sent by the author to the people of Guernsey, on January 10th, 1854. The original text in French is as follows: “sachez-le bien, quand on peut empêcher la mort, laisser mourir, c’est tuer”. For this valuable information, I thank Professor Alessandra Sant’Anna Bianchi and Professor Maurício José D’Escragnolle Cardoso (from The Federal University of Paraná – UFPR, in Brazil).
- (3) The first Table (in Section 2.1 above) was developed from the text *On the Escape of Tigers* (HADDON Jr., 1970). Thus, the second column presents a summary of the “Ten Strategies for Reducing These Losses” developed by the author. The examples mentioned in the third column were selected by me and, if they disagree with the author’s presentation, the errors are mine.
- (4) The second Table (in Section 3. above) contains two images taken by the author. In the top image, the traffic sign contains the following information: “Dangerous Road – next 30 km”. The bottom image was taken during the 3rd Global Ministerial Conference on Road Safety, held in Stockholm, Sweden in February 2020. The graph represents the evolution of the road safety system adopted by the Swedish Parliament in 1997: Vision Zero: together we save lives.

## APPENDIX: GLOSSARY OF TERMS

**HUMAN RIGHTS (Notion).** According to NORBERTO BOBBIO (1996, p. 18), ‘human rights are historical rights which emerge gradually from the battles which human being fight for their own emancipation and the transformations in living conditions which these struggles produce’. Human Rights are ‘rights common to all mankind, to every person as human being, which, therefore, are the result of its own nature, not mere political creations’ (COMPARATO, 2003, p. 20).

**PARADIGM (Notion).** The word paradigm has been used in distinct ways by THOMAS KHUN. In a broad sense, paradigm refers to scientific achievements. According to the author (2012, p. 10-11), these achievements “share these two characteristics”: (1) the paradigm is independent or distinct from previous theories or currents, which is why it distances its followers from other (previous or competing) currents.; and (2) the paradigm is broad enough to encompass the problems to be solved by people who adhere to “normal science”. Therefore, the paradigm constitutes the “criterion that so clearly proclaims a field a science” (2012, p. 22). The word paradigm is also used, in this essay, as model or standard of a science, corresponding to something that will serve as example to be followed.

### Author details:

Cássio Mattos Honorato, LL.M., Specialist in Road Traffic Law, has been a member of the State Prosecution Service in Paraná State (Brazil) since 1997. He is a former Military Police Officer of São Paulo State, who served as Lieutenant of the Highway Police Patrol (from 1990 to 1997) and holds a Bachelor Degree of Legal Science (Law School); a Specialist Degree (MBA) in Urban and Road Traffic Act, and has graduated Master of Law (LL.M., 2000-2003).

Author of four books and several scientific publications related to the traffic phenomenon. He participated in the Road Safety Legislation Workshops, which were held at the World Health Organization (WHO) in 2012, 2013 and 2014, and he collaborated with the translation (from English into Portuguese) of the manual *Strengthening Road Safety Legislation: a practice and resource manual for countries*, in 2015.

In addition to his professional activities, he currently also serves as a member of the Working Group to reduce deaths and injuries resulting from road traffic, in Parana State (Brazil).

Email: cmhonorato@mppr.mp.br

## REFERENCES

- BLISS, Tony; BREEN, Jeanne 2009, Implementing the recommendations of the World Report on Road Traffic Injury Prevention: country guidelines for the conduct of road safety management capacity reviews and the specification of lead agency reforms, investment strategies, and safe system projects, The World Bank Group, Washington (DC). Available in: <<http://documents.worldbank.org/curated/en/712181469672173381/Implementing-the-recommendations-of-the-world-report-on-road-traffic-injury-prevention-country-guidelines-for-the-conduct-of-road-safety-management-capacity-reviews-and-the-specification-of-lead-agency-reforms-investment-strategies-and>>
- BOBBIO, Norberto 1996, The Age of Rights, trans Allan Cameron. Polity Press, Cambridge.
- COMPARATO, Fábio Konder 2003, A afirmação histórica dos direitos humanos, 3rd edn, Saraiva, São Paulo (Brazil).
- ELVIK, Rune; CHRISTENSEN, Peter; AMUNDSEN, Astrid Helene 2004, Speed and road accidents: an evaluation of the Power Model, Institute of Transport Economics Norwegian Centre for Transport Research (TOI). Available in: <<https://www.toi.no/publications/speed-and-road-accidents-an-evaluation-of-the-power-model-article17882-29.html>>
- GLOBAL ROAD SAFETY PARTNERSHIP (GRSP); INTERNATIONAL FEDERATION OF RED CROSS AND RED CRESCENT SOCIETIES 2023, Speed management: a road safety manual for decision-makers and practitioners, second edition, Geneva. Available in: <<https://www.who.int/publications/m/item/speed-management--a-road-safety-manual-for-decision-makers-and-practitioners.-2nd-edition>>
- HADDON Jr., William 1968, The changing approach to epidemiology, prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively based, American Journal of Public Health, Vol. 58(8), p. 1431-1438. Available in: <<https://ajph.aphapublications.org/doi/10.2105/AJPH.58.8.1431>> Also available in: <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1228774/pdf/amjphnation00064-0115.pdf>>
- HADDON Jr., William 1970, On the Escape of Tigers: An Ecologic Note, American Journal of Public Health and the Nations Health, vol. 60/12, p. 2229-2234. Available in: <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1349282/pdf/amjphnation00041-0001c.pdf>>
- Haq, Gary; and John Whitelegg, John 2014, The Insanity of Normality: Reconceptualising the Road Safety Debate, WTPP: World Transport Policy & Practice, volume 20, issue 2-3, p. 114-126. Available in: <<https://static1.squarespace.com/static/619593021331d42c0b62a1c6/t/6244b71357c66f3e58969008/1648670494715/wtpp20.2-3+Paul+Mees.pdf>>
- HONORATO, Cássio M. 2015, A Human Rights Approach to Road Safety, WTPP: World Transport Policy & Practice, volume 21.2, p. 21-39. Available in: <<https://static1.squarespace.com/static/619593021331d42c0b62a1c6/t/63c5ba81be8a001386ae4cb7/1673902724223/wtpp21.2-April+2015.pdf>>
- KUHN, Thomas S. 2012, The Structure of Scientific Revolutions. 4th edn, The University of Chicago Press, Chicago.
- NORMAN, Leslie G. 1962, Road traffic accidents. Epidemiology, control and prevention, World Health Organization, Geneva. Available in: <<http://apps.who.int/iris/handle/10665/39723>>
- OrganiZation for Economic Co-Operation and Development (OECD) / INTERNATIONAL TRANSPORT FORUM (ITF) 2016, Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System, Paris. Available in: <[http://www.towardszerofoundation.org/wp-content/uploads/2016/10/Zero\\_road\\_deaths-SafeSystems.pdf](http://www.towardszerofoundation.org/wp-content/uploads/2016/10/Zero_road_deaths-SafeSystems.pdf)>
- RUMAR, Kåre 1999, Transport safety visions, targets and strategies: beyond 2000. 1st European Transport Safety Lecture, European Transport Safety Council, Brussels. Available in: <<https://archive.etsc.eu/documents/etsl1.pdf>>
- TINGVALL, Claes; HAWORTH, Narelle 1999, Vision Zero – An ethical approach to safety and mobility, Paper presented to the 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000, Melbourne. Available in: <<https://www.monash.edu/muarc/archive/our-publications/papers/visionzero>>
- UNITED NATIONS 2003, UNGA Res. A/57/309. Global road safety crisis. Fifth-seventh session, New York, 29 May 2023. Available in: <<https://docs.un.org/en/A/RES/57/309>>



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## REFERENCES CONTINUED

- UNITED NATIONS 2003, UNGA Res. A/58/228. Global road safety crisis. Report of the Secretary-General. Fifth-eighth session, New York, 07 Aug 2003. Available in: <[https://unece.org/DAM/trans/roadsafe/docs/SG\\_report\\_e.pdf](https://unece.org/DAM/trans/roadsafe/docs/SG_report_e.pdf)>
- UNITED NATIONS 2004, UNGA Res. A/58/289. Improving global road safety. Fifth-eight session, New York, 11 May 2004. Available in: <<https://digitallibrary.un.org/record/519469?v=pdf>>
- UNITED NATIONS 2005, UNGA Res. A/60/181. The global road safety crisis: progress on the implementation of General Assembly resolution 58/289. Sixtieth Session, New York, 1 Aug 2005. Available in: <<https://unece.org/DAM/trans/roadsafe/docs/A-60-181e.pdf>>
- UNITED NATIONS 2015, UNGA Res. A/70/1. Transforming our world. The 2030 Agenda for Sustainable Development. Seventieth Session, New York, 21 October 2015. Available: <[https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A\\_RES\\_70\\_1\\_E.pdf](https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf)>
- WORLD HEALTH ORGANIZATION (WHO) 2004, World Report on Road Traffic Injury Prevention, Geneva. Available in: <[http://www.who.int/violence\\_injury\\_prevention/publications/road\\_traffic/world\\_report/en/](http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/)>
- Whitelegg, John and Gary Haq, Gary; 2006, Vision Zero: adopting a target of zero for road traffic fatalities and serious injuries. Stockholm Environment Institute – University of York (UK). Available in: <[https://mediamanager.sei.org/documents/Publications/Future/vision\\_zero\\_FinalReportMarch06.pdf](https://mediamanager.sei.org/documents/Publications/Future/vision_zero_FinalReportMarch06.pdf)>
- WORLD HEALTH ORGANIZATION (WHO) 2011, Global Plan for the Decade of Action for Road Safety 2011-2020, Geneva. Available in: <<https://www.who.int/groups/united-nations-road-safety-collaboration/decade-of-action-for-road-safety-2011-2020>>
- WORLD HEALTH ORGANIZATION (WHO) 2013, Strengthening road safety legislation: a practice and resource manual for countries, Geneva. Available in: <<https://www.who.int/publications/i/item/strengthening-road-safety-legislation>>
- WORLD HEALTH ORGANIZATION (WHO) 2021, Global Plan Decade of Action for Road Safety 2021-2030, Geneva. Available in: <<https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030>>
- WORLD HEALTH ORGANIZATION (WHO) 2023, Global Status Report on Road Safety 2023, Geneva. Available in: <<https://www.who.int/publications/i/item/9789240086517>>
- WORLD HEALTH ORGANIZATION (WHO); INDIAN INSTITUTE OF TECHNOLOGY DELHI 2006, Road Traffic Injury Prevention: training manual, New Delhi. Available in: <<https://www.who.int/publications/i/item/9241546751>>



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